



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/646,289

08/21/2003

Son Ho

MP0390.1

9390

26703

7590

12/05/2006

HARNESS, DICKEY & PIERCE P.L.C.
5445 CORPORATE DRIVE
SUITE 400
TROY, MI 48098

EXAMINER

PATEL, KAUSHIKKUMAR M

ART UNIT

PAPER NUMBER

2188

DATE MAILED: 12/05/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/646,289

Applicant(s)

HO ET AL.

Examiner

Kaushikkumar Patel

Art Unit

2188

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 September 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-2, 4-7, 9-10, 12-15 and 17-33 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-7,9,10,12-15 and 17-33 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>9/25/2006</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on September 25, 2006 has been entered.

Response to Amendment

2. This office action is in response to applicant's communication filed September 25, 2006 in response to PTO office action mailed July 26, 2006. The applicant's remarks and amendments to the claims and/or specification were considered with the results that follow.

3. In response to the last office action, claims 1, 4-5, 9-10, 12-13 and 17 have been amended. Claims 18-33 have been added. Claims 3, 8, 11 and 16 have been canceled. As a result, claims 1-2, 4-7, 9-10, 12-15 and 17-33 remain pending in this application.

Response to Arguments

4. Applicant argues (remarks on page 14) that Zaidi only teaches first memory interface and Zaidi has no need for a switch and which does not selectively connect cache to one of the first and second memory interfaces. Examiner respectfully

Art Unit: 2188

disagrees with this. As stated in column 23 (referring to figs. 20-22), lines 22-33, “Switched channel memory controller” allows multiple DMA (and processors) to simultaneously communicate with multiple output channels and “CPUs supply a request and an address to a switched channel memory controller (MAC)”. Zaidi further teaches (col. 23, lines 40-45), that CPU bus can be connected to an external flash memory through one channel and SDRAM through another channel. The above description clearly indicates that there are separate communicative interfaces between the CPU and flash as well as CPU and SDRAM.

5. Applicant's remaining arguments with respect to claims 1, 5, 13, 18 and 26 have been considered but are moot in view of the new ground(s) of rejection.

Information Disclosure Statement

6. The information disclosure statement (IDS) submitted on September 25, 2006 has considered by the examiner.

Claim Objections

7. Claims 13-15 and 17 are objected to under 37 CFR 1.75 as being a substantial duplicate of claims 5-7 and 9 respectively. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 1-2, 5-7, 10, 13-15, 18-19 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zaidi et al. (US 6,601,126 B1) (Zaidi herein after), Jeddeloh (US 7,133,972 B2) and Loafman (US 2005/0021916 A1).

As per claims 1 and 18, Zaidi teaches memory storage system that is accessed by a first central processing unit (CPU) (fig. 1, item 100 and item 112, also see figs. 20-23), comprising:

a line cache including a plurality of pages that are accessed by the first CPU (fig. 1, item 126. Also caches are known to store pages accessed by CPU, see background art section of present application); and

a first memory device that stores data that is loaded into said line cache when miss occurs (fig.1, item 108 is connected to processor via cache 126 to CPU 112, column 22, lines 65-67, teaches processor use cache to access data from memory 108 and as per present application's background art section, data are loaded from lower latency memories to cache when miss occurs);

a second memory device (figs. 1-2 and 20-23, items 106, 108, 248, 250 and indicated as flash and SDRAM);

a line cache control system that controls data flow between said line cache, the first CPU, said first memory device and said second memory device (CPU accessing data from lower level storage devices through cache teaches cache control system), and that includes:

a first line cache interface that is associated with the first CPU, that receives a first program read request from the first CPU and that generates a first address from said first program read request (figs. 20-22 shows cache of CPU is connected to memory devices through MAC, which inherently teaches interfaces and CPU accessing information from cache as explained above inherently requires generating address);

a first memory interface that communicates with said first memory device and a second memory interface that communicates with said second memory device (figs. 20-23, flash and SDRAM is connected to MAC);

a switch that selectively connects said line cache to one of said first and second memory interfaces, wherein when said line cache receives said first address, said line cache control system compares said first address to stored addresses in said line cache, returns data associated with said first address if match occurs and loads page of said line cache when miss occurs [caches are known to receive addresses from processors and comparing those addresses to stored addresses and providing data to processor if hit occurs and loading pages from lower higher latency memory in case of cache miss (see background of invention in present application)], (column 23, lines 31-34 and lines 41-45, taught as CPUs supply a request and an address, the address includes both the port, device or memory bank address and the requested memory

Art Unit: 2188

location address. Referring to figs. 20-22, col. 23 lines 22-29, "switched channel memory controller" allows multiple DMA (and processors) to simultaneously communicate with multiple output channels. Also, col. 23, lines 40-45, suggests that CPU bus can be connected to an external flash memory through one channel and SDRAM through another channel. These statements clearly indicate that there are separate and selective communication interfaces between the devices). (switches providing separate/distinct/exclusive [limitation of claim 18] interfaces are known in the art, because a separate and independent interface avoids bus or memory bank conflict and hence increases the speed of the system, see Jeddeloh, US 7,133,972, fig. 3, col. 4, lines 30-64,).

Zaidi fails to teach loading n pages from sequential locations from memory. Loafman teaches when miss occurs in memory (cache); system preloads consecutive pages from lower latency storage (Loafman, par. [0026]) into memory. It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the memory storage system of Zaidi by prefetching some extra sequential pages when page fault (cache miss) occurs and the requested page is being loaded from higher latency storage to memory (cache), because during sequential access of data it is highly likely that nearby data will be accessed in near future, and by prefetching adjacent (extra) pages will avoid cache miss next time CPU references the sequential data and thus, improving the performance (see Loafman paragraphs [0011]-[0013]).

As per claim 2, Loafman teaches that if program continue sequentially accessing prefetched pages, than prefetching more pages (four and eight and so on) into cache. (Loafman, fig. 2, paragraph [0026]).

Claims 5 and 6 are rejected under same rationales as applied to claims 1 and 2. As Loafman teaches that as long as CPU accesses data in sequential manner, than controller keeps prefetching additional pages (2,4,8 etc. Loafman, fig. 2, items 210, 220, 230) and thus next sequential address is already read ahead in the cache and hence no cache miss occurs.

As per claim 7, Loafman teaches loading 2 pages, then 4 and then 8, sequentially (Loafman, fig. 2, paragraph [0026]), which inherently teaches m^{th} page from n pages (accessing 1st then 2nd and loading 4, and then 8 pages, in case of two pages $n = 2$ and reading 2nd page teaches reading m^{th} (2nd) page of two pages or 3rd in case of 4 pages preloaded and hence m is greater than one and less than or equal to n and prefetching 4 or 8 pages teaches additional n pages).

Claims 10 and 13-15 are rejected under same rationales as applied to claims 1-2 and 5-7 above.

As per claim 19, combination of Zaidi, Jeddeloh and Loafman teach limitations of independent claim 18, but fail to teach cache translating an address. Computer/storage systems with cache using virtual index (virtual cache) or physical index (physical cache) as well as virtual memory addressing are well known in the art. The physical caches requires address translation for data access from cache and hence cache translating virtual to physical addressing is known in the art, and examiner takes official notice of

Art Unit: 2188

that. Physical caches are simpler to build; hence it would have been obvious to one having ordinary skill in the art at the time of the invention to use physical cache performing address translation in the system of Zaidi, Jeddelloh and Loafman.

As per claim 25, Loafman teaches loading multiple lines of data from secondary storage device to cache as explained with respect to claim 1 above.

10. Claims 4, 9, 12, 17, 26 and 33 are rejected under **35 U.S.C. 103(a)** as being unpatentable over Zaidi, Jeddelloh and Loafman as applied to claims 1-2, 5-7 and 13-15 above, and further in view of Barroso et al. (US 6,725,334 B2).

As per claims 4, 9, 12 and 17, Zaidi, Jeddelloh and Loafman teach a dual processor system with two caches (fig. 2, items 202 and 214, first and second processors, and items 208 and 224, two caches). Zaidi, Jeddelloh and Loafman inherently teach cache interface with first and second CPUs and both generates read requests and hence first and second address and providing an exclusive interface as taught in claim 1. Zaidi teaches system with two caches for two processors but fails to teach cache arbitration device which communicates with first and second cache interfaces and resolves cache access conflicts between first and second CPUs. Barroso teaches a second level shared cache with switch (fig. 1, item 130 and 120), which provides interfaces with first and second CPU and arbitrates between first and second CPU (column 4, lines 10-21).

It would have been obvious to one having ordinary skill in the art at the time of invention to modify the multiple cache with multiple processor system of Zaidi and used

Art Unit: 2188

one cache with switch as taught by Barroso to reduce the cost and the waste of the cache capacity and shared cache avoids duplication of data in individual caches (column 1, lines 45-65).

Claim 26 recites storage system with two processors and ordered data requests. Combination of claims 1 and 4, as taught above teaches dual processor system with shared cache and arbitration device. Jeddelloh teaches switch with arbitration logic to determine memory access priorities and ordering requests according to priority (Jeddelloh, col. 4, line 65 – col. 5, line 2).

As per claim 27, combination of Zaidi, Jeddelloh, Loafman and Barroso teaches limitations of independent claim 26, but fail to teach cache translating an address. Computer/storage systems with cache using virtual index (virtual cache) or physical index (physical cache) as well as virtual memory addressing are well known in the art. The physical caches requires address translation for data access from cache and hence cache translating virtual to physical addressing is known in the art, and examiner takes official notice of that. Physical caches are simpler to build; hence it would have been obvious to one having ordinary skill in the art at the time of the invention to use physical cache performing address translation in the system of Zaidi, Jeddelloh and Loafman.

As per claim 33, Loafman teaches loading multiple lines of data from secondary storage device to cache as explained with respect to claim 1 above.

Art Unit: 2188

11. Claims 20-24 are rejected under **35 U.S.C. 103(a)** as being unpatentable over Zaidi, Jeddeloh and Loafman as applied to claim 18 above, and further in view of Alexander et al. (US 6,131,155).

As per claims 20 and 23, Zaidi, Jeddeloh and Loafman teach all the limitations of independent claim 18, but fail to teach direct interface to bypass cache. Alexander teaches a CPU programmed to bypass a cache when necessary (Alexander, abstract).

It would have been obvious to one having ordinary skill in the art at the time of the invention to utilize the direct access interface to memory, bypassing the cache as taught by Alexander in the system of Zaidi, Jeddeloh and Loafman, because data caches provides performance improvement only if program execution performs repeated accesses of data over a short period of time to a small group of data and large amounts of data transfers degrades the performance by the phenomenon known as thrashing, so bypassing a cache and directly reading burst data from memory increases the performance (Alexander, abstract, col. 2, lines 21-56). Also providing a direct/exclusive and independent interface avoids bus or memory bank conflict as explained with respect to claims 1, 4, 18 and 26 above.

As per limitation of claims 21-22 and 24, Alexander teaches that when necessary in order to fetch or store (reading from and writing/programming to memory device) data items directly from/to the memory, ensuring data accesses exhibiting a high degree of locality are made to the cache, while those accesses that are non-local are made directly to the main memory, bypassing the cache (Alexander, abstract), proves that

Art Unit: 2188

depending upon addresses certain access are only performed through the direct memory interface, bypassing the cache.

12. Claims 28-32 are rejected under **35 U.S.C. 103(a)** as being unpatentable over Zaidi, Jeddeloh, Loafman and Barroso as applied to claim 26 above, and further in view of Alexander et al. (US 6,131,155).

As per claim 28, Zaidi, Jeddeloh, Loafman and Barroso teach all the limitations of independent claim 26, but fail to teach direct interface to bypass cache. Alexander teaches a CPU programmed to bypass a cache when necessary (Alexander, abstract).

It would have been obvious to one having ordinary skill in the art at the time of the invention to utilize the direct access interface to memory, bypassing the cache as taught by Alexander in the system of Zaidi, Jeddeloh, Loafman and Barroso, because data caches provides performance improvement only if program execution performs repeated accesses of data over a short period of time to a small group of data and large amounts of data transfers degrades the performance by the phenomenon known as thrashing, so bypassing a cache and directly reading burst data from memory increases the performance (Alexander, abstract, col. 2, lines 21-56). Also providing a direct/exclusive and independent interface avoids bus or memory bank conflict as explained with respect to claims 1, 4, 18 and 26 above.

As per limitation of claims 29 and 30-32, Alexander teaches that when necessary in order to fetch or store (reading from and writing/programming to memory device) data items directly from/to the memory, ensuring data accesses exhibiting a high degree of

Art Unit: 2188

locality are made to the cache, while those accesses that are non-local are made directly to the main memory, bypassing the cache (Alexander, abstract), proves that depending upon addresses certain access are only performed through the direct memory interface, bypassing the cache.

As per limitation of claim 31, Zaidi and Barroso teach an arbiter and MAC (Zaidi, fig. 2, items 242, 244) and switch (Barroso, fig.1, item 120) to resolve memory access conflict (Zaidi, column 23, lines 40-45) but fail to teach arbiter for direct read/write interface. It would have been obvious to one having ordinary skill in the art at the time of the invention would provide arbiter for direct (bypassing cache interface) interface, because when multiple CPUs accessing memory device, providing arbitration avoids the conflict for same data.

Double Patenting

13. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Art Unit: 2188

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

14. Claims 1-2, 4-7, 9-10, 12-15 and 17-33 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-11 of copending Application No. 10/626507 in view of Loafman and Alexander. With respect to claims 1-2, 4-7, 9-10, 12-15 and 17-33 of present application, the limitations of first and second CPU, two memory devices, arbitrating devices and line cache with direct interfaces are claimed in co-pending application 10/626507 in claims 1 and 6-10 respectively and remaining limitations of claims of present application, such as loading n pages of line cache for memory and bypassing the cache are taught above with respect to secondary references of Loafman and Alexander above.

This is a provisional obviousness-type double patenting rejection.

Conclusion

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Fu et al. (6,725,339) teaches processing ordered memory requests.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kaushikkumar Patel whose telephone number is 571-272-5536. The examiner can normally be reached on 8.00 am - 4.30 pm.


Art Unit: 2188

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hyung Sough can be reached on 571-272-6799. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Kaushikkumar Patel
Examiner
Art Unit 2188


kmp


HYUNG SOUGH
SUPERVISORY PATENT EXAMINER
12/01/06